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Black Duck Joint Venture Helicopter Survey in Québec

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2003 Black Duck Joint Venture Helicopter Survey – Québec

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To find out more about the American Black Duck and many other waterfowl species, and to follow the Black Duck Joint Venture activities in Québec, visit our Web site at the following address:

www.qc.ec.gc.ca/faune/sauvagine/html/waterfowl.html

Readers should note that this publication uses the International System of Units: thousands are separated from hundreds by a space (53 833 km²; 1 231 448 pairs), and decimals are separated from units by a comma (9,98 pairs/100 km²; -7,8°C).

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[4]Canadian Coast Guard - Atlantic Region

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1.0 Introduction

The main objective of the Black Duck Joint Venture (BDJV) survey is to provide statistically reliable indices of breeding population trends and relative densities of American Black Duck (hereafter, Black Duck) and other waterfowl species throughout the primary breeding range of the Black Duck. The BDJV study area in Canada includes the provinces of New Brunswick, Nova Scotia, Newfoundland (including part of Labrador), Québec (southern part) and Ontario (east-central). This huge territory was divided in 4 strata to reflect the distribution of 3 different Black Duck populations according to banding reference units, and ecozones. Stratum 1 is in the Atlantic Maritime Ecozone. The 3 other strata are in the Boreal Shield Ecozone which was divided approximately according to the banding reference limits in Canada. The 70°30' west meridian of longitude divides Stratum 2 (Eastern Boreal Shield) from Stratum 3 (Central Boreal Shield). 76°30' W divides Stratum 3 and Stratum 4 (Western Boreal Shield). Strata 1 and 2 are part of the same banding reference unit. Each spring, the study area is surveyed twice, (a) by the Canadian Wildlife Service (CWS) using helicopter and (b) by the U.S. Fish and Wildlife Service (USFWS) using aircraft (usually referred to the fixed-wing survey). This report deals with the BDJV helicopter survey in Québec.

2.0 Methods

The BDJV helicopter survey covers approximately 503 800 km^2 of the Black Duck's main breeding grounds in Québec. The study area includes most of the Boreal Shield Ecozone (Bird Conservation Region [BCR] 8, Boreal Softwood Shield, and BCR 12, Boreal Hardwood Transition) and the northern part of the Atlantic Maritime Ecozone (BCR 14, Atlantic Northern Forest; Figure 1). Québec's coverage of the eastern Canada survey includes parts of Strata 1, 2 and 4, and all of Stratum 3. The survey began in 1990 with 83–10×10 km (100 km^2) plots systematically distributed within the study area. Beginning in 1996, plot size was reduced to 5×5 km (25 km^2) and a rotational plot design was implemented whereby each of the 156 plots are surveyed twice over a 4-year period. The transition to this new system was made possible without loosing long-trend analysis capability by keeping most of the southwest 5×5 km quadrants from the original set of 100 km^2 plots. In the rotational design, a letter (A, B, C or D) was randomly assigned to the plots of each stratum. Half of the plots (78) are surveyed each year beginning with Plots A and B in the first year, B and C in the second year, etc. The 78 plots surveyed in 2003 were exactly the same as those surveyed in 1999 (Plots D and A) which completes the second full rotation cycle.

The same survey method was used throughout the 1990–2003 period. Surveys were carried out using a Bell 206L (Long Ranger) helicopter equipped with skids and bubble windows to enhance observer visibility. All waterbodies and wetlands within the plots were surveyed. Depending on habitat and topography, surveys were flown at 15–50 m above ground level and at 60–100 km/h. The survey crew consisted of 2 observers in Stratum 1, and 3 observers in Strata 2, 3 and 4. All waterfowl observations (see Appendix 1 for scientific names of species) as well as some other aquatic birds,

mammals and reptiles were directly recorded by the front seat observer on 1:50 000 topographic maps of the plots and later entered into a computer database. Basic data recorded for each individual or group of birds observed (i.e. one record per observation) were: 1) plot identification; 2) date; 3) location of the birds (UTM); 4) species code; 5) number of males; 6) number of females; 7) number of birds of unknown sex. Indicated pairs in this report were calculated using the standardized method developed for the BDJV helicopter survey in Eastern Canada (Appendix 2).

The survey is carried out during the nest-initiation and the beginning of the incubation period of the Black Duck, an early nesting duck species. To determine the timing of the survey relative to nest initiation, we calculated a phenology index (PI) which is the ratio of the number of paired males (1 male + 1 female) to that of unattended males (lone and flocked drakes). A PI of 1,0 is considered optimal for the Black Duck and other species with sex ratios close to 1,0 and is indicative of a survey made when half the pairs involved have initiated nesting while the other half have started incubation. A PI value much greater than 1,0 indicates a survey early in the breeding season where migrants are still in the area and breeding pairs may not be on their nesting territories, which could result in an overestimation of the breeding population. On the other hand, a very small PI indicates a late survey relative to the nesting phenology where some pairs may be missed because drakes are abandoning the nesting hens (for most species, incubating females cannot be counted from the helicopter). The latter situation leads to underestimation of the indicated pair numbers.

3.0 Spring Conditions

The warm and very dry conditions we experienced last summer in Québec resulted in low waterfowl production. The following fall had average weather conditions as did winter with the exception of southern Québec where colder than average temperatures were recorded. Winter conditions along the United States Atlantic coast, where most of our waterfowl species spend winter, were also very cold and harsh. In the boreal forest of Québec, breeding waterfowl conditions this spring ranged from normal to good.

4.0 Results and Discussion

Every plot was surveyed by experienced observers. Daniel Bordage, Christine Lepage and Shirley Orichefsky covered all plots in Strata 2, 3 and 4. The 4 plots of Stratum 1 were covered by Myrtle Bateman and Randy Hicks. The survey was undertaken between May 5th and May 31st 2003 (1990–2003 average = 6–30 May; Table 1). A mean temperature of 14°C was the highest recorded since the beginning of the survey in 1990 (1990–2003 mean = 10°C; Table 1). Average survey time on plots (36 min) was similar to those recorded in previous years (1996–2003 average = 33 min). The Lake Saint-Jean ice thaw, which gives us an idea of spring conditions in central Québec (Stratum 3), occurred at the fourth latest date recorded since 1990 (1990–2003 average ice thaw = 9 May; Table 1).

Table 2 shows that most species had phenology indices (PI) close to the optimal value of 1,0. Two species had very high PI: the American Wigeon (PI = 8,00) and the Surf

Scoter (PI = 10,7). These high PIs probably resulted from the very low number of birds observed for these two species. Overall, recorded phenology indices in 2003 point out that the timing of the survey was good.

Numbers of indicated pairs are shown in Table 3 for all loon, goose and duck species breeding in the study area and that were consistently observed during the survey. With a total of 410 791 indicated pairs of dabbling and diving ducks, 2003 had the second highest count on record since the beginning of the survey in 1990 (Table 3). This 2003 estimate of total duck population is 5,5% above the 2002 estimate of 389 347 indicated pairs and 48% above the long term 1990–1999 average of 276 662 indicated pairs (Table 4). Total indicated pairs of divers (*Aythyini* and *Mergini*) increased by 9,8% this year compared to 2002 while dabbler numbers stayed the same (*Cairinini* and *Anatini*; +0,6%).

The 1990–2003 trends of the various species surveyed are shown in Figures 2 to 27. Overall total number of ducks increased since 1990 to a record high estimate in 2000 (Figure 2). This long term increase was observed both for dabblers and divers. However, the record high number of divers was observed in 2003. Divers, who were more abundant than dabblers from 1990 to 1995, showed comparable densities from 1996 to 2001, and then were more abundant then dabblers in the last two years (Figure 2).

A record high number of Common Loon indicated pairs was observed in 2003 (Figure 3). Recall that the low estimation of 1996 resulted from late ice thaw that year for many large lakes used by loons. Following a steady decline from 1990 to 1995, the Canada Goose breeding population, at the southernmost part of their distribution range, had increased considerably since the hunting season was closed in 1995 (Figure 4). In Québec, the hunting season for this species was reopened partially in 1999 then completely in 2002. Following two consecutive years of decline, the Canada Goose population largely increased in 2003 to the second highest indicated pair estimate on record since 1990. Overall, both the Atlantic Population (AP; Strata 3 and 4) and the North Atlantic Population (NAP; Stratum 2) showed a similar trend but the range of variations was lower for the NAP (Figure 5). The number of nests recorded (stated as number of nests counted per 100 km^2 to account for differential yearly sampling effort) showed similar patterns to the indicated pair trends (Figure 6). A record high density of nests was recorded in 2003 and clutch size estimated from the air did not vary much from the 1990–2003 average of 4,46 eggs/nest (Figure 7). The Black Duck breeding population in the study area decreased by 12% in 2003 compared to last year (Table 4). Overall, the Black Duck population is increasing since 1993 (Figure 10). Mallard IP numbers rose quite consistently since 1990 (Figure 11) with a very large increase of 145% this year compared to 2002 (Table 4). The second most abundant waterfowl species in the study area, the Ring-necked Duck, also greatly increased in 2003 (+96%) to the second highest breeding population estimate since 1990 (Table 4; Figure 15). The Common Goldeneye indicated pair numbers increased by 4,9% this year from last year (Table 4) and the 2003 estimate for this species is at a record high since the beginning of the survey in 1990 (Figure 22). A record high indicated pair estimate was also observed in 2003 for the Surf Scoter (Figure 21). Finally, the ten most abundant

species have actual population estimates above the long term 1990–1999 average (Table 4).

5.0 Discussion

Results of the 2003 BDJV survey showed that Black Duck indicated pair numbers were 12% down compared to last year. This decline was to be expected considering the 2002 low waterfowl productivity and the cold temperatures recorded on the wintering grounds. However, the unexpected result was that the Black Duck was one of the few species which declined in 2003. Overall, the indicated pair estimate for all duck species combined was about 6% higher than last year. Moreover, some species such as Common Goldeneye and Surf Scoter had record high numbers in 2003.

The BDJV helicopter survey allows us to evaluate the breeding population trends and relative abundance of 20 species of loons and waterfowl in southern Québec. A look at the trend figures reveals acceptable year-to-year variations as well as fairly smooth tracks of yearly population changes for most species. The precision of annual indicated pair estimates (see SE) is good for many surveyed species. Annual coefficients of variation were usually below 10% for Black Duck and below 20% for many other abundant species.

Over the years, the BDJV helicopter survey has proven to be a valuable and effective tool for evaluating population trends and relative abundance of Common Loon and waterfowl species breeding in southern Québec. 2003 was the fourteenth consecutive year of the BDJV survey program in Canada.

Table 1. Sample plot size, sampling effort, habitat and weather conditions recorded during the Black Duck Joint Venture Helicopter Survey in Québec 1990–2003.

Descriptor	1990–1995	1996	1997	1998	1999	2000	2001	2002	2003
Plot identification	–[1]	A–B	B–C	C–D	D–A	A–B	B–C	C–D	D–A
Plot size (km)	10×10	5×5	5×5	5×5	5×5	5×5	5×5	5×5	5×5
Surveyed area (km^2)	3 500–8 200[2]	1 950	1 950	1 950	1 950	1 950	1 950	1 950	1 950
Sampling effort (%)	0,7–1,6[2]	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4
Beginning of survey	2–11 May[2]	6 May	12 May	5 May	6 May	4 May	6 May	29 April	5 May
End of survey	23 May – 4 June[2]	24 May	6 June	29 May	31 May	2 June	30 May	3 June	31 May
Mean temperature (°C)	8–11[2] (-4–30)[2]	5 (-8–14)[2]	8 (1–18)[2]	13 (2–22)[2]	13 (-2–25)[2]	9 (-5–25)[2]	13 (0–25)[2]	6 (-7–21)[2]	14 (2–28)[2]
Mean time on plot (min)	81–97[2] (20–192)[2]	24 (13–44)[2]	34 (17–59)[2]	31 (14–51)[2]	36 (20–58)[2]	36 (19–64)[2]	32 (15–55)[2]	34 (13–52)[2]	36 (16–59)[2]
Saint-Jean Lake ice thaw	7–20 May[2]	12 May	7 May	3 May	8 May	7 May	9 May	1 May	13 May

[1]The rotational sampling plan using a letter for plot identification began in 1996.
[2]Minimum–maximum.

Table 2. Phenology indices (PI) of duck species observed during the Black Duck Joint Venture Helicopter Survey in Québec 1990–2003.

Species	1990–1995[1]	1996	1997	1998	1999	2000	2001	2002	2003
DABBLERS									
Wood Duck	0,35–3,25	3,50	0,60	0,25	0,60	1,57	0,92	1,57	0,38
Green-winged Teal	0,88–10,2	6,09	0,57	0,62	1,28	5,09	0,50	2,94	1,77
American Black Duck	0,78–2,44	5,22	1,16	0,88	1,03	1,77	0,50	1,57	1,28
Mallard	0,10–1,06	0,35	0,27	0,20	0,28	0,62	0,19	1,50	0,45
Northern Pintail	0,00–1,00	0,20	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]
Blue-winged Teal	1,50–6,00	-[2]	0[3]	-[2]	-[2]	2,00	3,00	-[2]	-[2]
American Wigeon	0,00–3,50	-[2]	0,50	-[2]	-[2]	-[2]	1,00	-[2]	8,00
DIVERS									
Ring-necked Duck	1,18–3,42	1,33	1,68	1,67	3,14	2,64	3,16	1,37	2,60
Greater Scaup	0,00–2,50	-[2]	0[3]	-[2]	-[2]	1,67	-[2]	-[2]	0[3]
Lesser Scaup	0,75–4,26	-[2]	0[3]	-[2]	-[2]	0[3]	-[2]	-[2]	-[2]
Unidentified scaup	1,00–4,00	-[2]	-[2]	-[2]	-[2]	2,67	-[2]	-[2]	-[2]
Black Scoter	0,33–30,0	1,00	-[2]	-[2]	-[2]	0[3]	-[2]	-[2]	-[2]
Surf Scoter	0,79–5,33	-[2]	-[2]	5,00	3,60	8,00	-[2]	12,0	10,7
Common Goldeneye	0,87–1,77	1,35	0,68	0,97	1,54	1,67	1,17	1,56	1,44
Barrow's Goldeneye	1,00–3,50	3,00	0,67	0,33	-[2]	-[2]	1,75	-[2]	-[2]
Bufflehead	2,25–7,57	0,60	5,00	-[2]	-[2]	1,50	-[2]	3,17	1,00
Hooded merganser	0,93–1,81	1,47	2,36	1,00	1,39	1,57	1,45	1,49	1,48
Common Merganser	0,82–1,68	1,14	1,22	0,81	1,08	1,60	1,23	1,26	1,51
Red-breasted Merganser	0,80–6,00	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]

[1]Minimum–maximum.
[2]No unattended male observed.
[3]At least one unattended male observed but no paired male observed.

Table 3. Breeding population estimates (total indicated pairs / 503 800 km^2) from the Black Duck Joint Venture Helicopter Survey in Québec 1990–2003.

Species	1990–1995[1]	1996	1997	1998	1999	2000	2001	2002	2003
LOONS									
Common Loon	14 775	10 851	25 319	18 860	24 286	21 185	19 894	20 410	29 195
GEESE									
Canada Goose	15 889	22 477	17 052	22 477	35 137	37 462	33 587	28 161	36 945
DABBLERS									
Wood Duck	2 450	2 325	2 325	1 292	4 134	5 684	6 201	4 650	5 167
Green-winged Teal	12 856	23 252	14 468	11 109	18 860	41 854	17 568	21 702	21 961
American Black Duck	80 339	106 056	94 947	107 736	155 145	158 116	121 300	144 164	127 113
Mallard	8 224	18 860	9 818	8 267	19 635	25 578	14 210	10 334	25 319
Northern Pintail	173	2 067	258	0	0	258	0	517	0
Blue-winged Teal	617	517	1 033	517	775	1 550	1 033	0	258
American Wigeon	624	1 033	1 550	0	775	7 173	517	258	2 842
Subtotal	105 284	154 111	124 400	128 921	199 324	238 465	160 828	181 626	182 660
DIVERS									
Ring-necked Duck	51 014	40 821	55 289	39 012	67 690	83 967	52 705	41 854	82 158
Greater Scaup	857	1 033	258	0	0	4 909	0	258	1 033
Lesser Scaup	2 164	517	517	0	0	258	0	0	258
Unidentified scaup	751	258	0	0	0	4 134	0	0	0
Black Scoter	919	517	258	258	775	775	0	0	0
Surf Scoter	2 492	1 809	3 875	8 009	5 942	5 684	9 301	4 909	10 076
Common Goldeneye	41 224	39 271	42 371	32 295	49 605	57 614	45 213	63 556	66 657
Barrow's Goldeneye	1 207	1 033	1 292	2 842	517	258	2 842	258	0
Bufflehead	2 625	3 617	2 067	0	517	1 292	0	7 751	2 067
Hooded merganser	11 654	12 660	12 660	12 918	26 611	23 252	15 243	27 386	20 927
Common Merganser	37 998	26 094	40 046	33 845	34 620	41 079	41 596	61 231	44 696
Red-breasted Merganser	1 503	0	0	0	0	342	0	517	258
Subtotal	154 407	127 629	158 632	129 179	186 277	223 481	166 900	207 721	228 131
Total ducks	259 691	281 740	283 032	258 101	385 601	461 946	327 728	389 347	410 791

[1] 1990–1995 mean.

Table 4. Change (%) between the number of indicated pairs (IP) observed in 2003 compared to 2002 and 1990–1999 mean; species are listed based on a decreasing value of the 1990–2003 mean IP population estimates from the Black Duck Joint Venture Helicopter Survey in Québec 1990–2003.

		Mean IP Density / 100 km^2		Mean IP Population (503 800 km^2)		% Change in 2003 compared to	
#	Species	1990–1999	1990–2003	1990–1999	1990–2003	2002	1990–1999 mean
1	American Black Duck	18,8	21,2	94 592	106 901	-12	**+34**[1]
2	Ring-necked Duck	10,1	10,9	50 889	54 970	**+96**	**+61**
3	Common Goldeneye	8,2	9,1	41 088	45 995	**+4,9**	**+62**
4	Common Merganser	7,2	7,8	36 259	39 371	-27	**+23**
5	Canada Goose	3,8	4,7	19 248	23 474	**+31**	**+92**
6	Common Loon	3,3	3,7	16 797	18 475	**+43**	**+74**
7	Green-winged Teal	2,9	3,5	14 483	17 708	**+1,2**	**+52**
8	Hooded Merganser	2,7	3,1	13 477	15 827	-24	**+55**
9	Mallard	2,1	2,6	10 593	12 955	**+145**	**+139**
10	Surf Scoter	0,69	0,92	3 459	4 611	**+105**	**+191**
11	Wood Duck	0,49	0,66	2 478	3 320	**+11**	**+109**
12	Bufflehead	0,44	0,47	2 195	2 361	-73	-5,8
13	Barrow's Goldeneye	0,26	0,23	1 292	1 163	-[2]	-[2]
14	American Wigeon	0,14	0,23	710	1 153	**+1000**	**+300**
15	Lesser Scaup	0,28	0,21	1 402	1 038	+[3]	-82
16	Greater Scaup	0,13	0,18	644	903	**+300**	**+61**
17	Red-breasted Merganser	0,18	0,14	902	718	-50	-71
18	Blue-winged Teal	0,13	0,13	655	671	+[3]	-61
	Unidentified scaup	0,09	0,13	476	635	0[4]	-100
19	Black Scoter	0,15	0,11	732	579	0[4]	-100
20	Northern Pintail	0,07	0,06	336	296	-[2]	-[2]
	Dabblers	24,6	28,4	123 846	143 003	**+0,6**	**+47**
	Divers	30,3	33,4	152 816	168 171	**+9,8**	**+49**
	Total ducks	54,9	61,8	276 662	311 174	**+5,5**	**+48**

[1]Increases are in bold.
[2]The species was observed in 2002 but not in 2003.
[3]The species was observed in 2003 but not in 2002.
[4]The species was neither observed in 2002 nor in 2003.

Table 5. Breeding population estimates of Atlantic population of Canada Goose (number of indicated pairs / 350 000 km^2; Strata 3 and 4) and North Atlantic population of Canada Goose (number of indicated pairs / 105 3000 km^2; Stratum 2) from the Black Duck Joint Venture survey in Québec 1990–2003.

Population	1990–1995[1]	1996	1997	1998	1999	2000	2001	2002	2003
Atlantic	11 407	15 638	11 863	13 211	23 726	25 613	22 108	17 795	25 613
North Atlantic	3 645	5 552	4 212	7 275	9 190	9 573	9 190	8 233	9 190

Table 6. Number of Canada Goose nests and clutch size estimates from the Black Duck Joint Venture Helicopter Survey in Québec 1990–2003.

	1990–1995[1]	1996	1997	1998	1999	2000	2001	2002	2003
Number of nests	24 (9–39)[2]	9	5	8	15	18	22	13	26
Number of nests / 100 km²	0,37 (0,26–0,48)[2]	0,46	0,26	0,41	0,77	0,92	1,13	0,67	1,33
Number of nests with recorded clutch size	19 (7–37)[2]	6	4	5	14	18	18	9	23
Mean clutch size (SE)	4,34	5,67 (0,21)	4,25 (0,75)	4,60 (0,51)	3,79 (0,41)	4,61 (0,29)	4,56 (0,18)	4,33 (0,24)	4,57 (0,29)

[1]1990–1995 mean.
[2]Minimum-maximum.

Figure 1. Study area of the Black Duck Joint Venture helicopter survey in Québec 1990–2003.

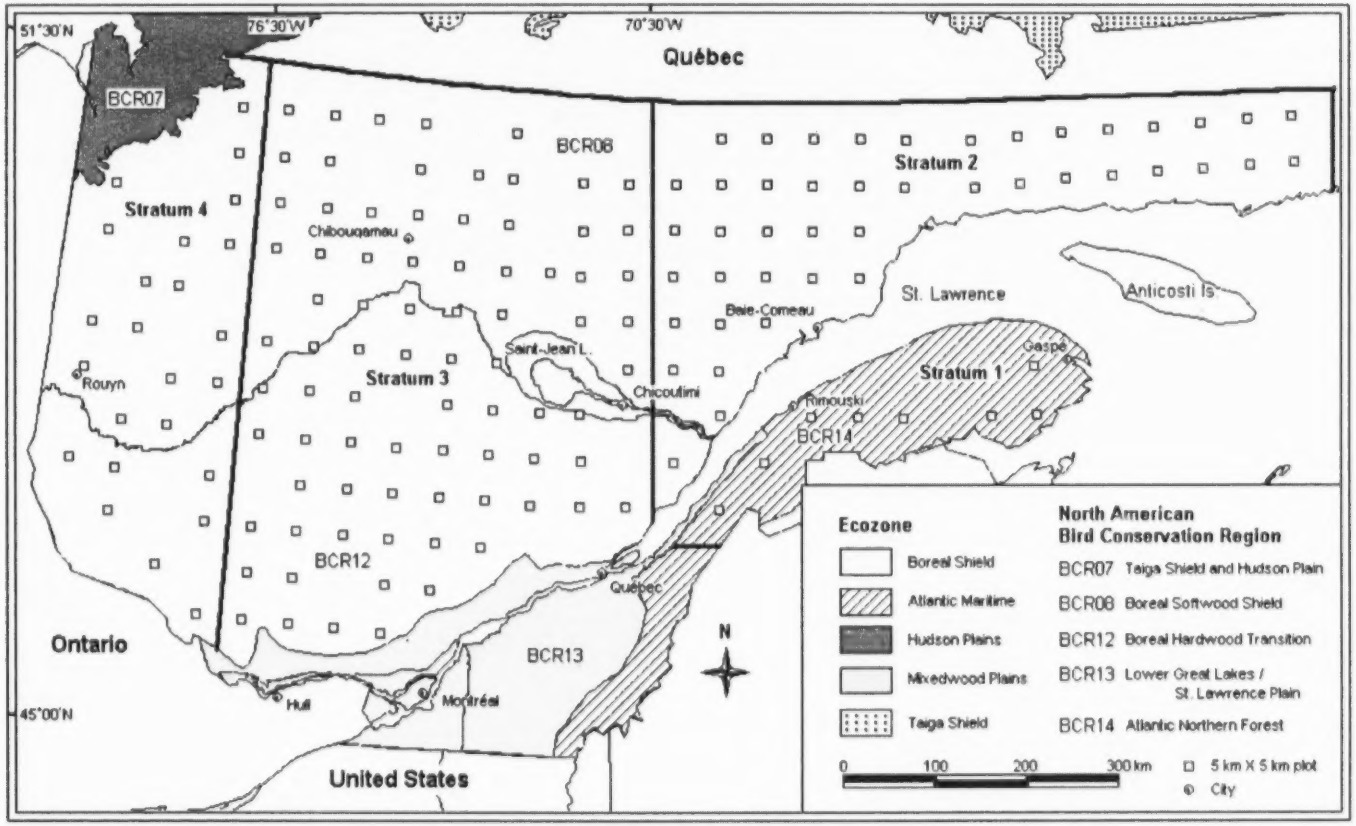


Figure 2. Trend in the breeding waterfowl population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

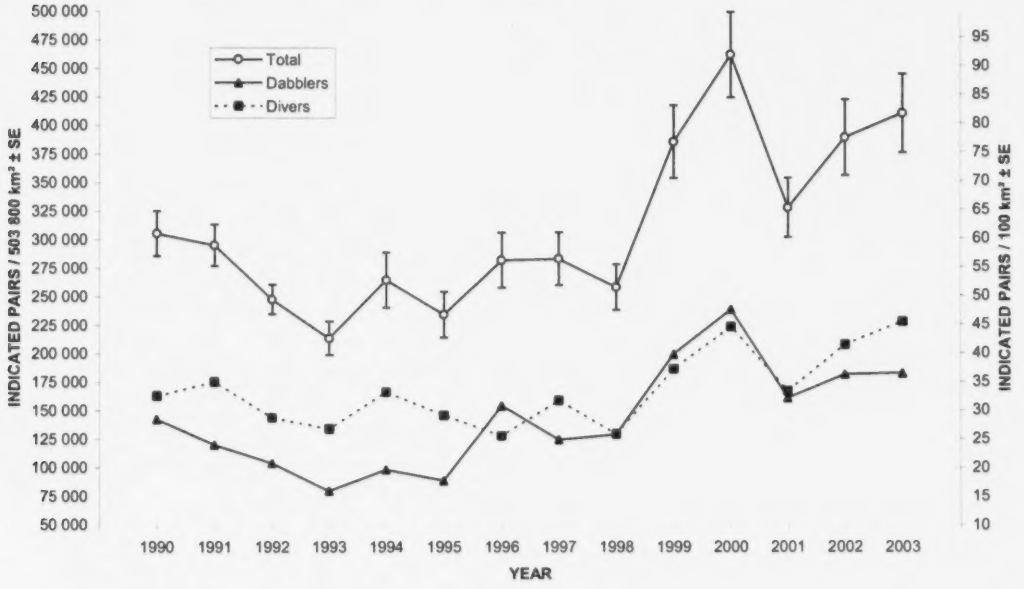


Figure 3. Trend in the Common Loon breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

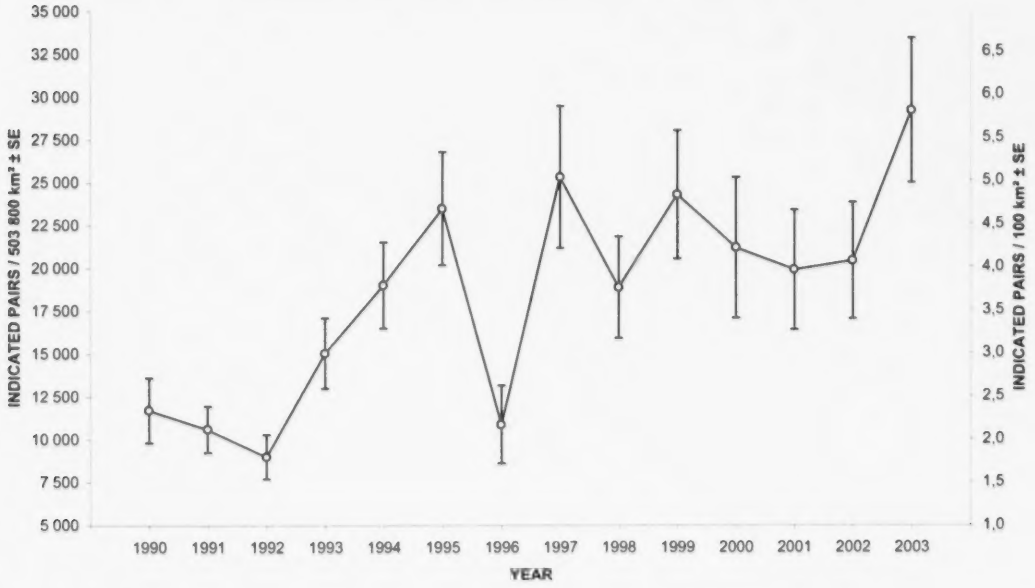


Figure 4. Trend in the Canada Goose breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

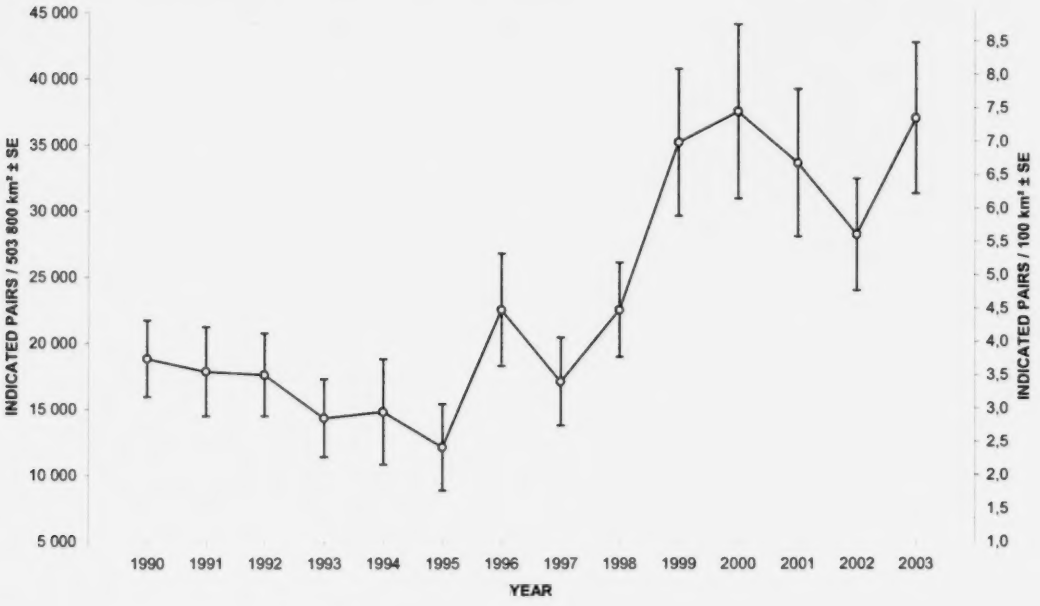


Figure 5. Trend in the Atlantic and North Atlantic Canada Goose populations in southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

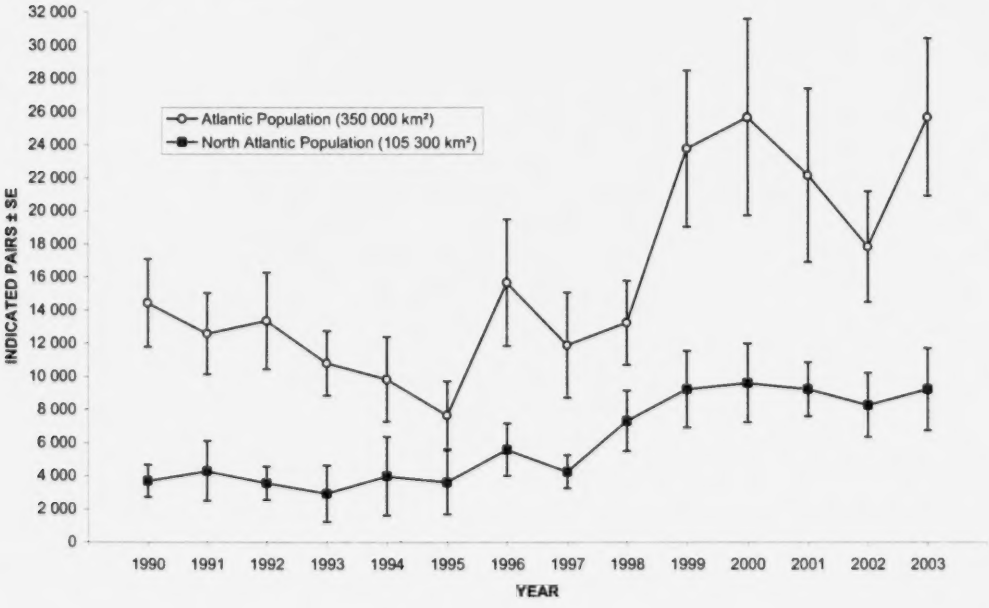


Figure 6. Trend in the number of nests of Canada Geese in southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

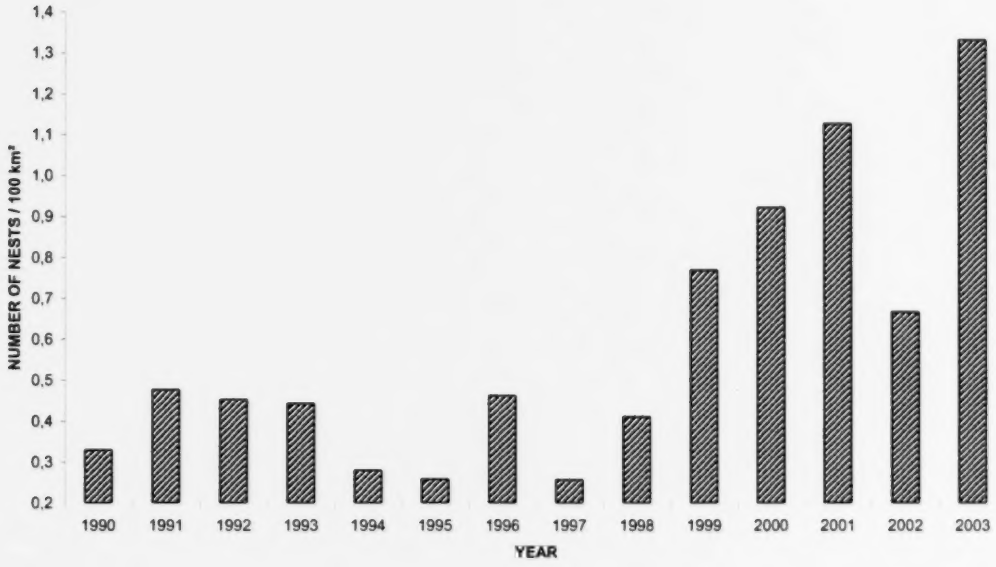


Figure 7. Trend in the Canada Goose clutch size in southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

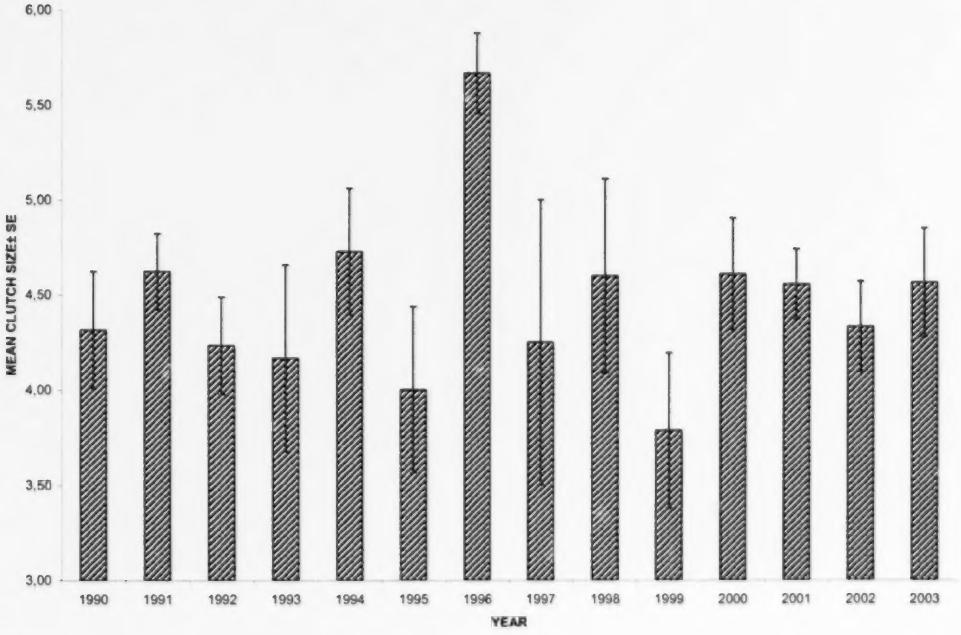


Figure 8. Trend in the Wood Duck breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

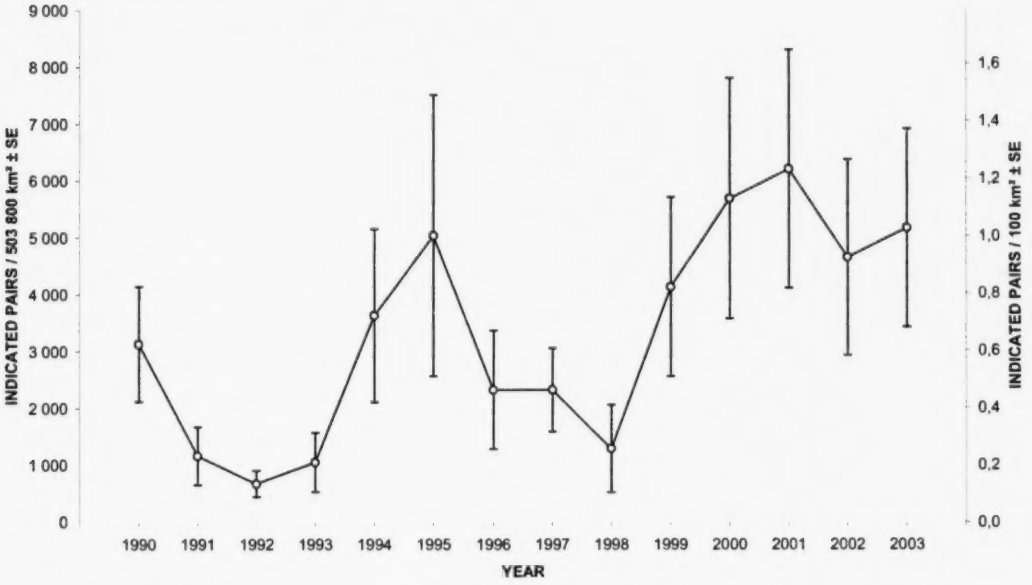


Figure 9. Trend in the Green-winged Teal breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

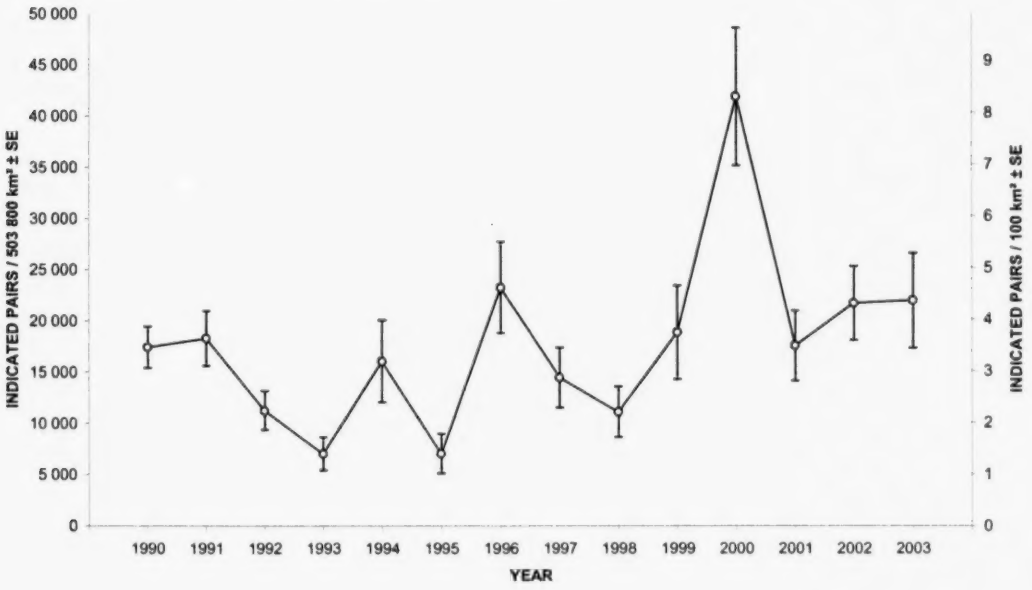


Figure 10. Trend in the American Black Duck breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

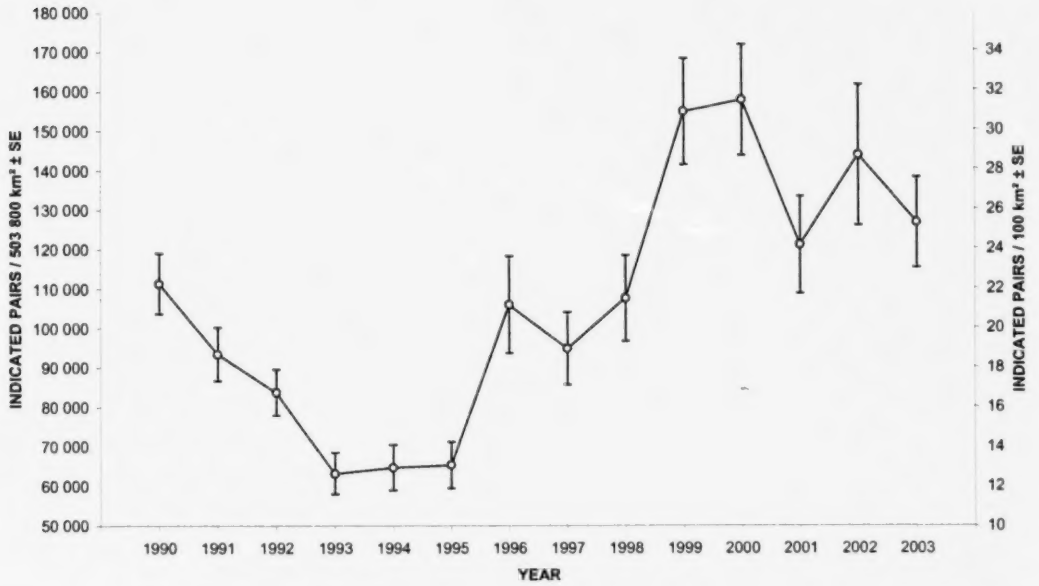


Figure 11. Trend in the Mallard breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

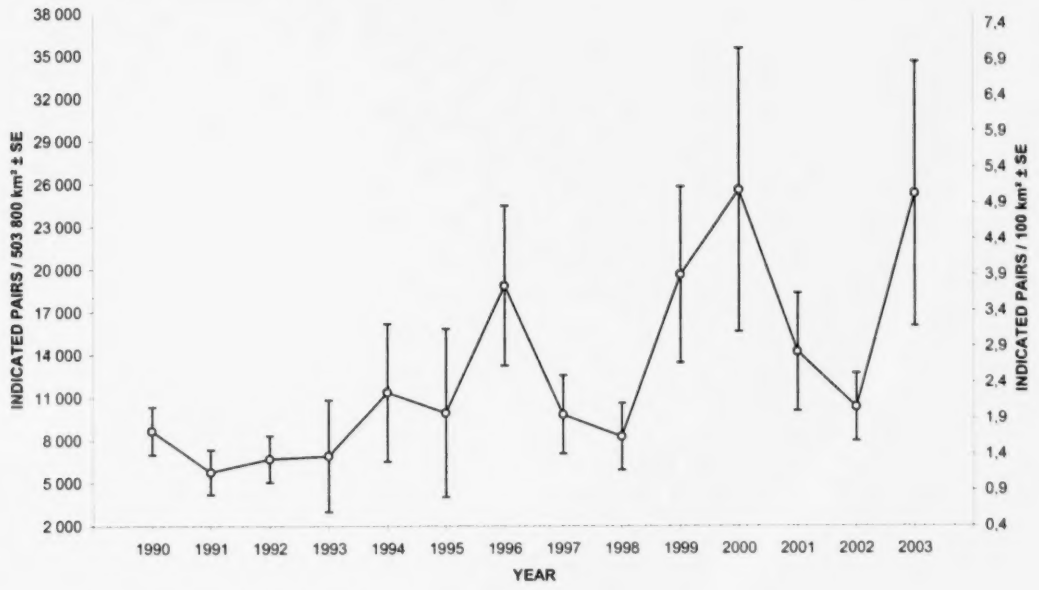


Figure 12. Trend in the Northern Pintail breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

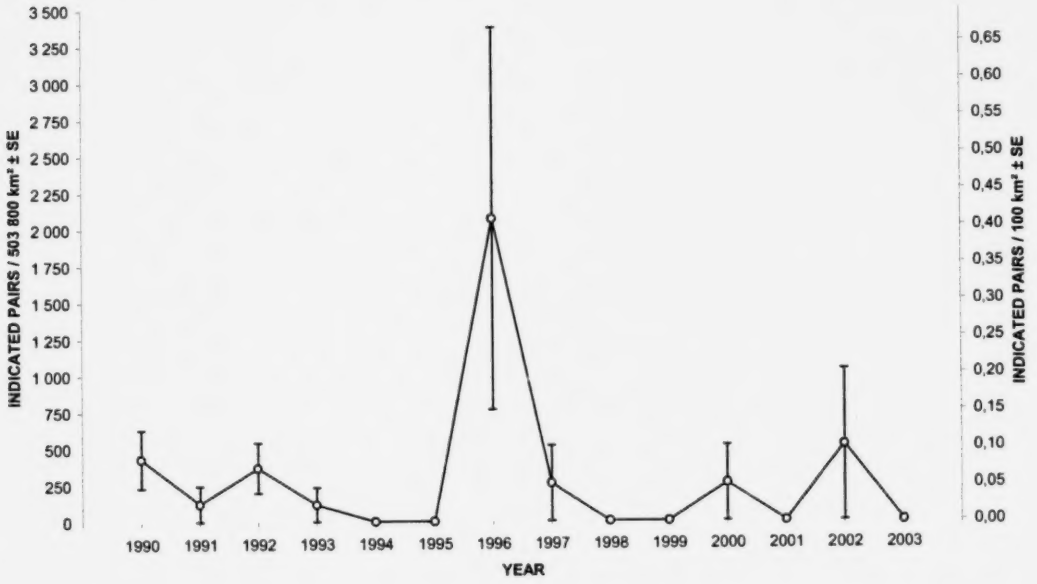


Figure 13. Trend in the Blue-winged Teal breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

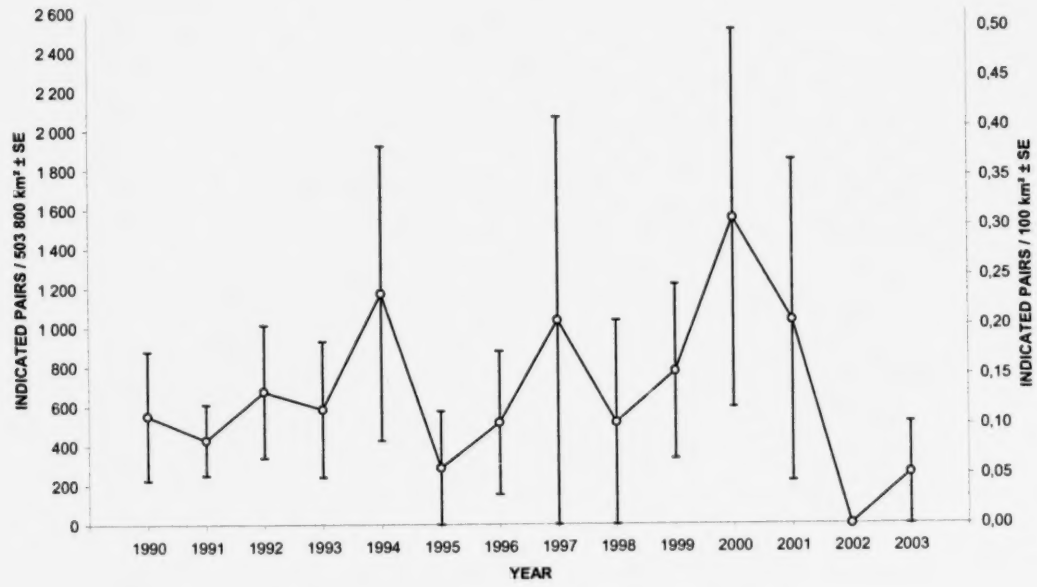


Figure 14. Trend in the American Wigeon breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

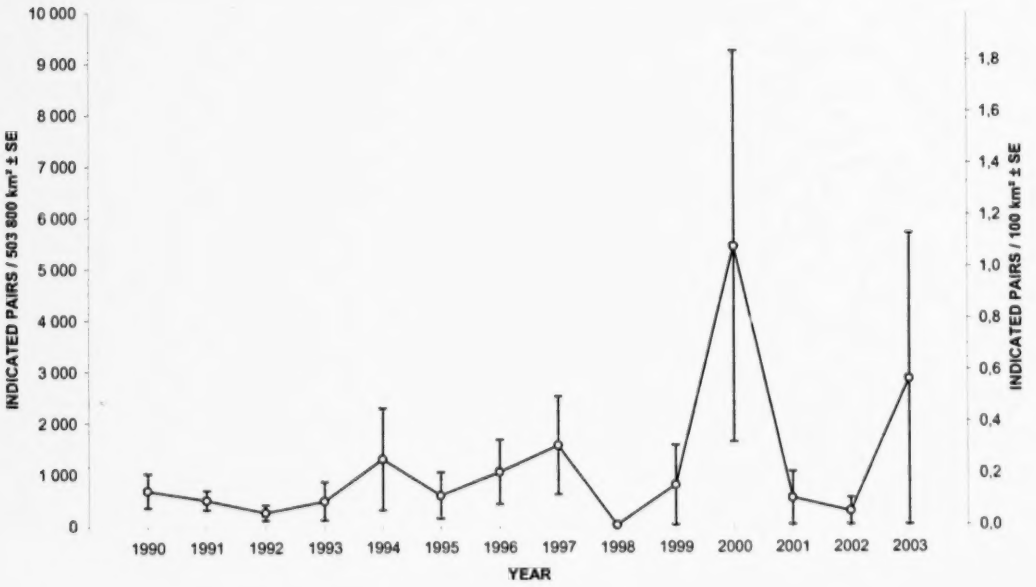


Figure 15. Trend in the Ring-necked Duck breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

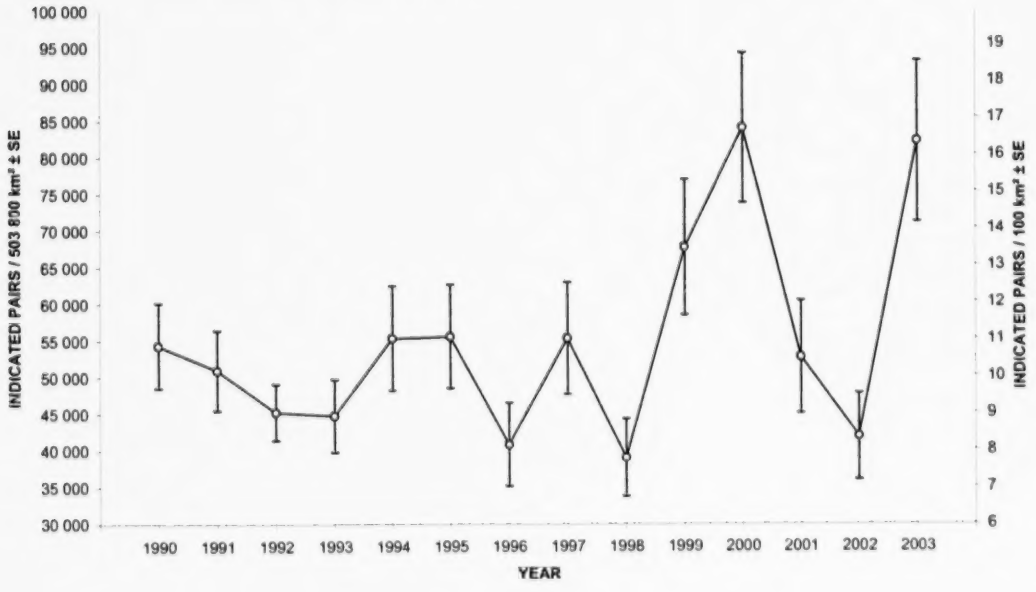


Figure 16. Trend in the Greater Scaup breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

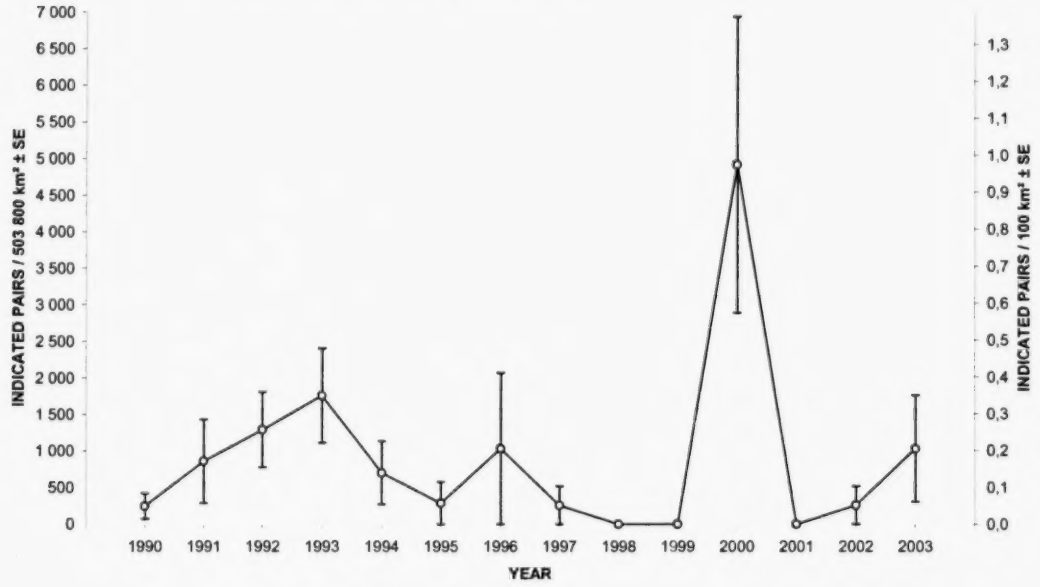


Figure 17. Trend in the Lesser Scaup breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

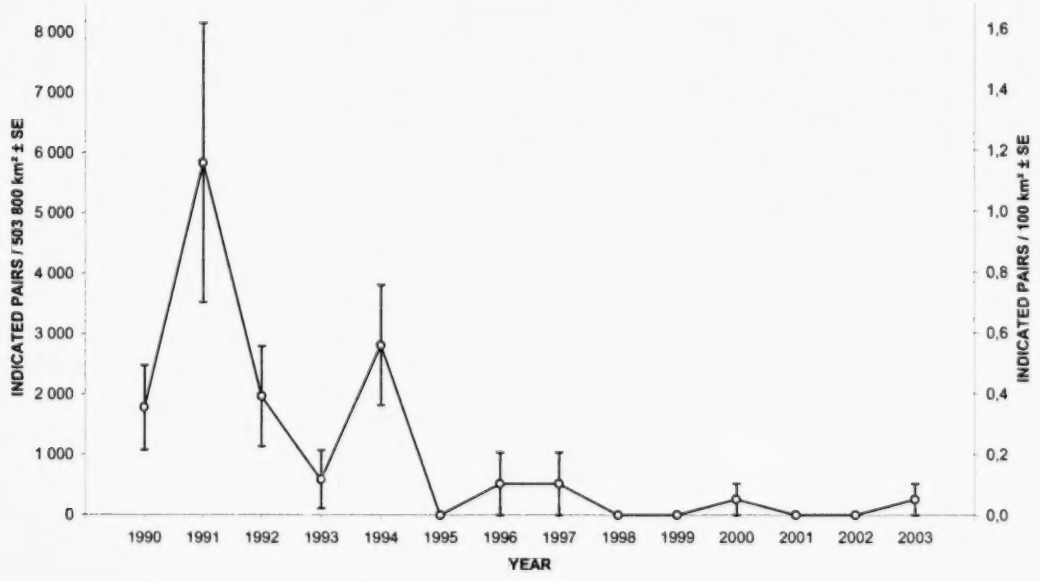


Figure 18. Trend in the unidentified scaup breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

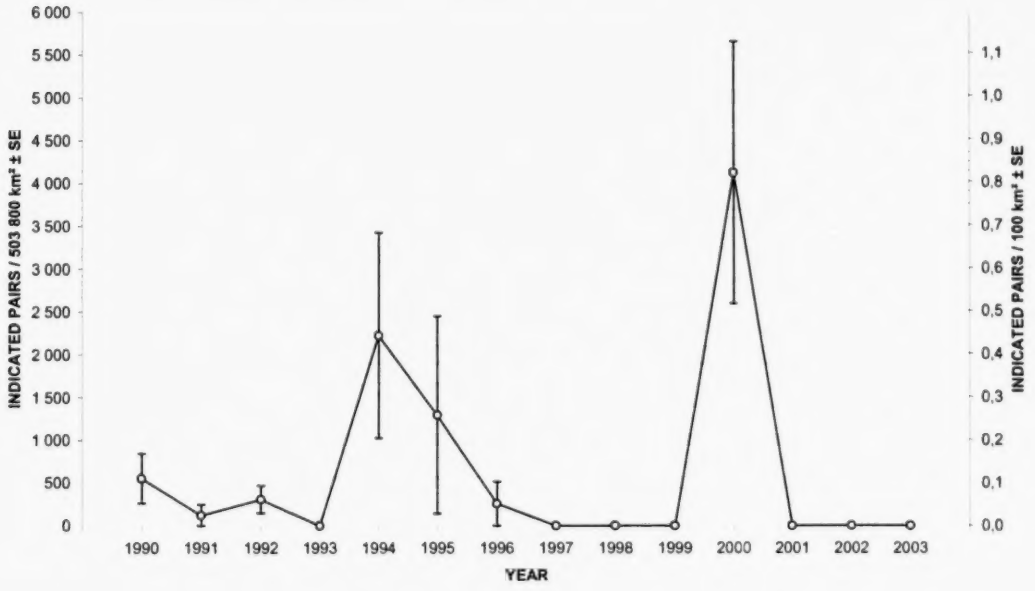


Figure 19. Trend in the scaup breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003; solid line = total scaup.

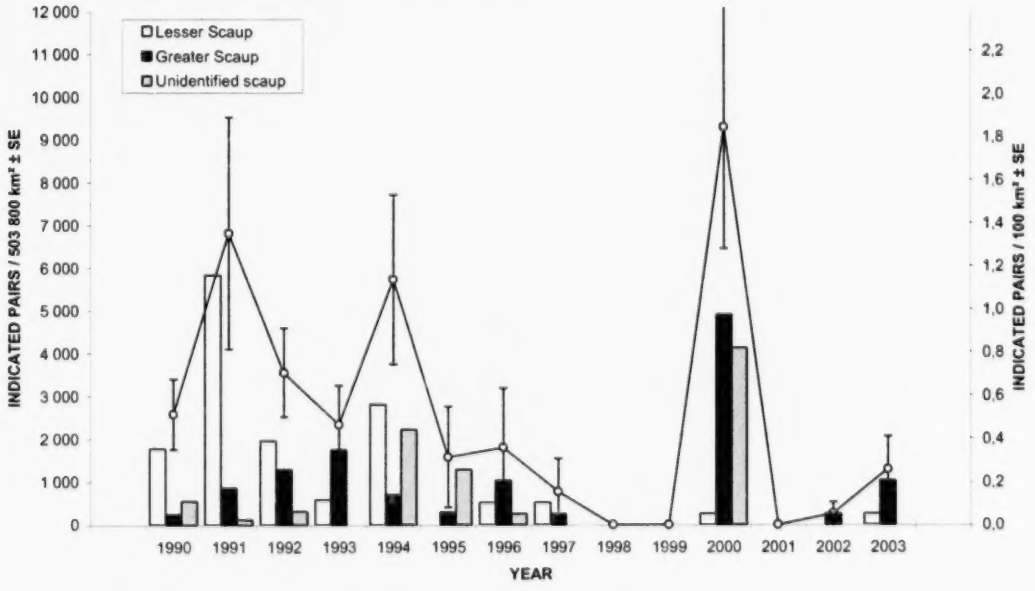

Lesser Scaup
Greater Scaup
Unidentified scaup
INDICATED PAIRS / 503 800 km² ± SE
INDICATED PAIRS / 100 km² ± SE
YEAR
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003

Figure 20. Trend in the Black Scoter breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

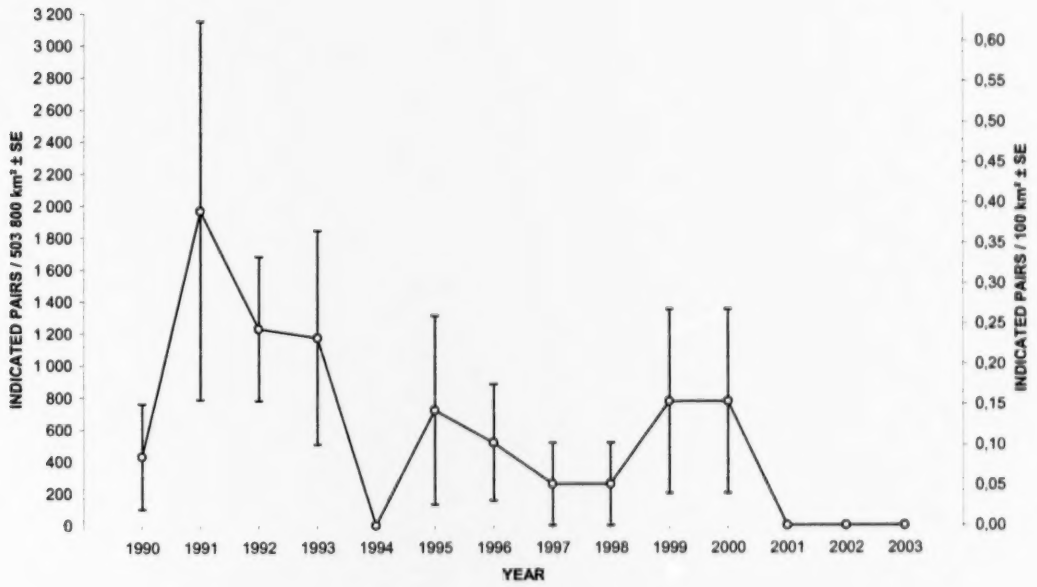


Figure 21. Trend in the Surf Scoter breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

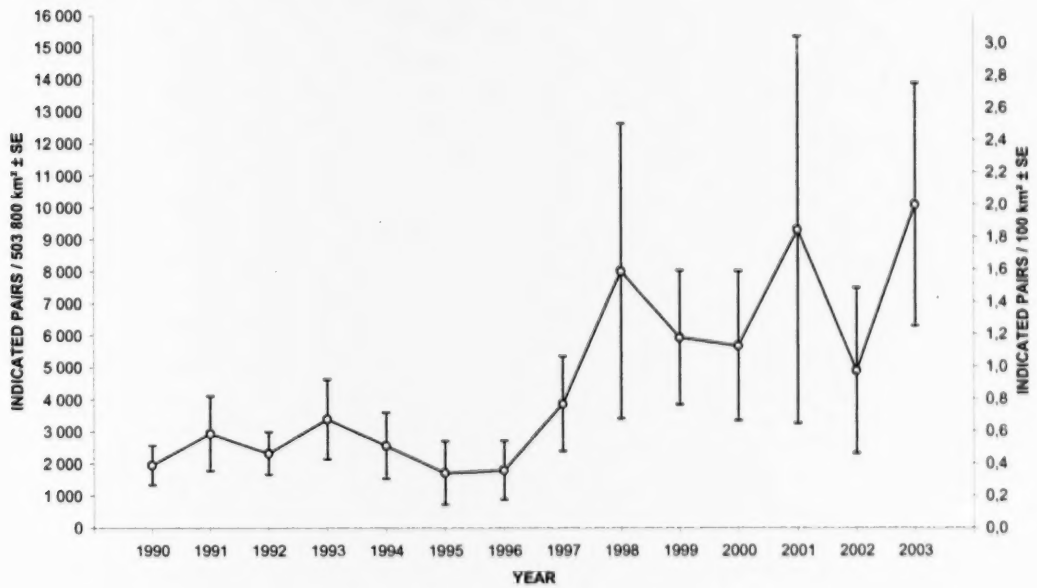


Figure 22. Trend in the Common Goldeneye breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

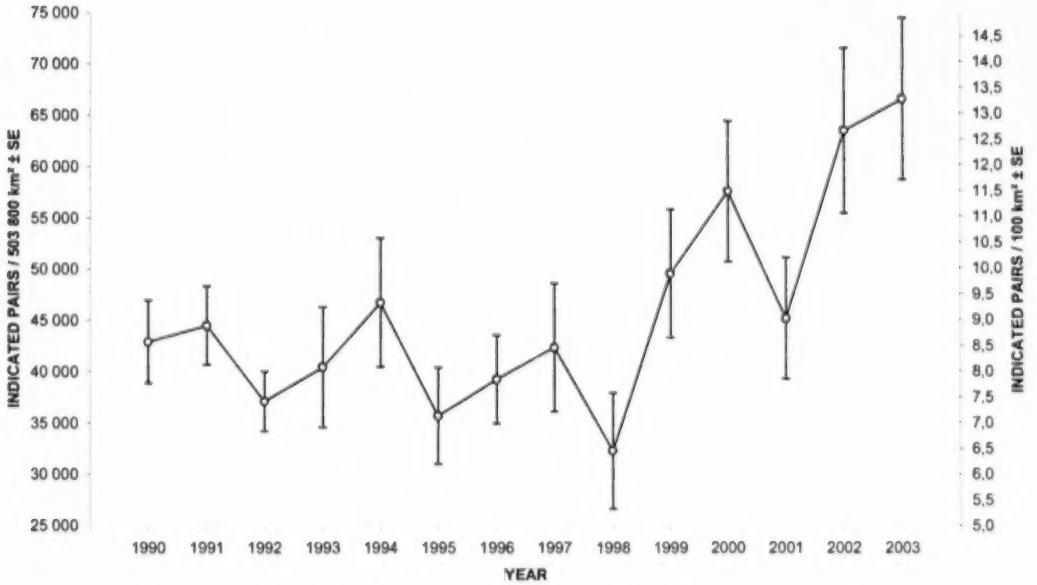


Figure 23. Trend in the Barrow's Goldeneye breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

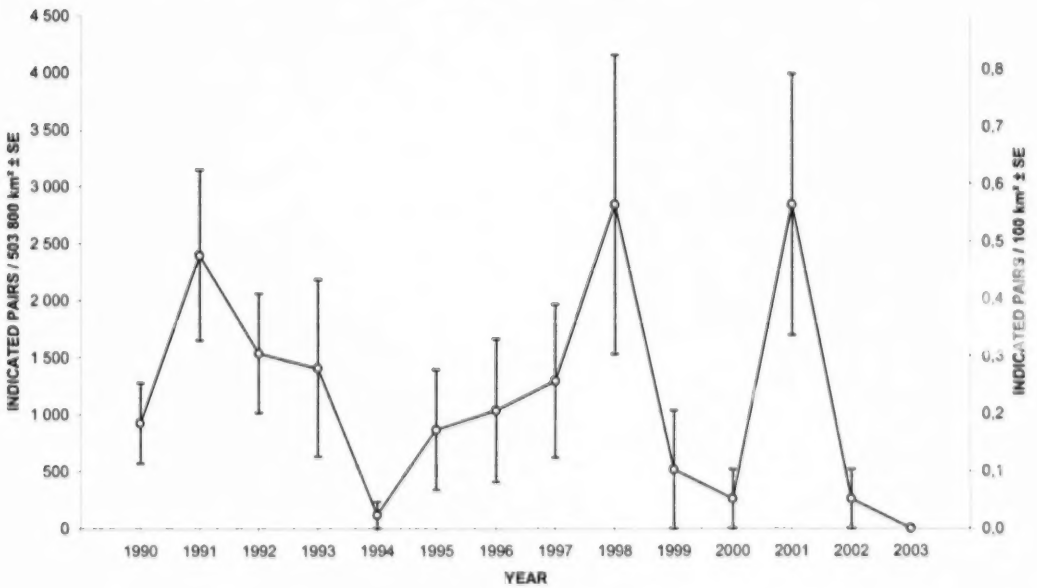


Figure 24. Trend in the Bufflehead breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

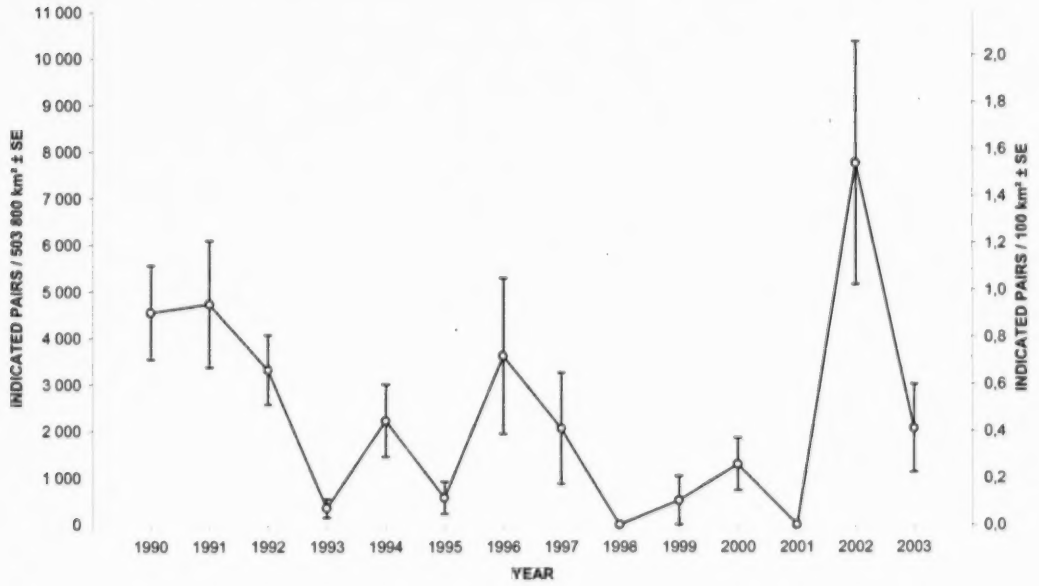


Figure 25. Trend in the Hooded Merganser breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

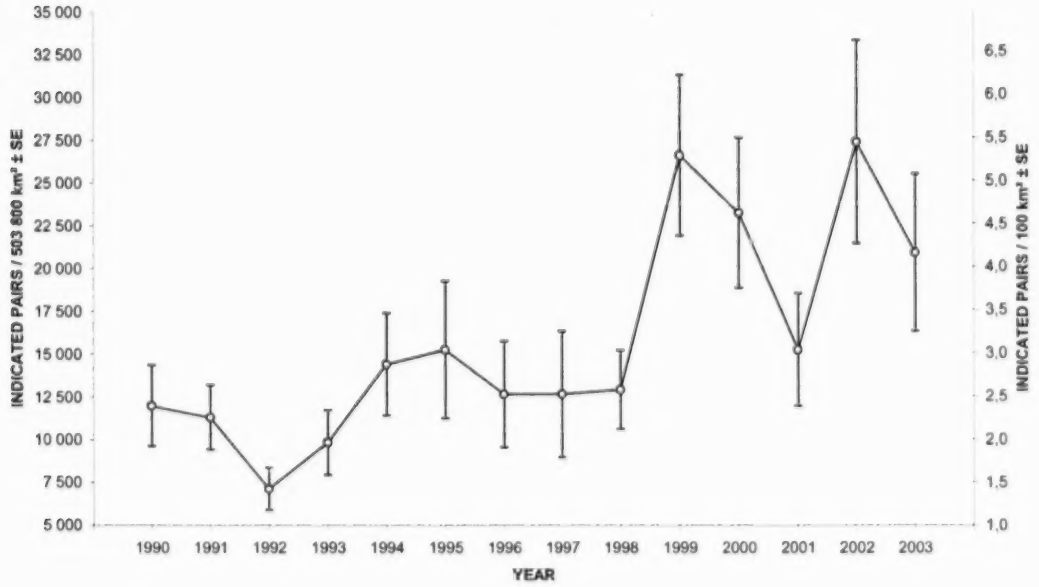


Figure 26. Trend in the Common Merganser breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.

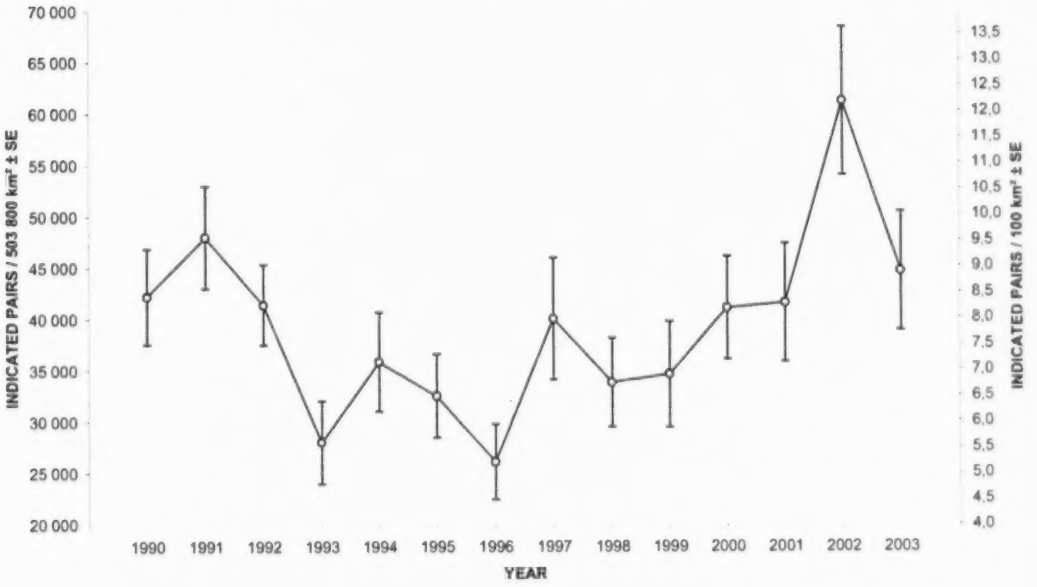
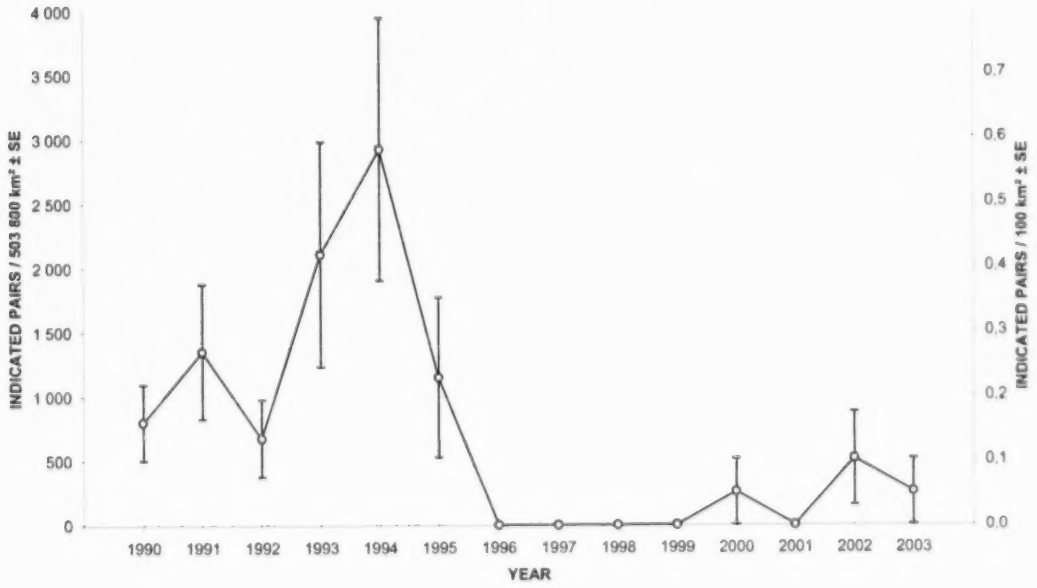


Figure 27. Trend in the Red-breasted Merganser breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2003.



Appendix 1. English, French, and Scientific names of species covered by the Black Duck Joint Venture helicopter survey in southern Québec 1990–2003.

English	French	Scientific
Common Loon	Plongeon huard	*Gavia immer*
Canada Goose	Bernache du Canada	*Branta canadensis*
Wood Duck	Canard branchu	*Aix sponsa*
Green-winged Teal	Sarcelle d'hiver	*Anas crecca*
American Black Duck	Canard noir	*Anas rubripes*
Mallard	Canard colvert	*Anas platyrhynchos*
Northern Pintail	Canard pilet	*Anas acuta*
Blue-winged Teal	Sarcelle à ailes bleues	*Anas discors*
American Wigeon	Canard d'Amérique	*Anas americana*
Ring-necked Duck	Fuligule à collier	*Aythya collaris*
Greater Scaup	Fuligule milouinan	*Aythya marila*
Lesser Scaup	Petit Fuligule	*Aythya affinis*
Black Scoter	Macreuse noire	*Melanitta nigra*
Surf Scoter	Macreuse à front blanc	*Melanitta perspicillata*
Common Goldeneye	Garrot à œil d'or	*Bucephala clangula*
Barrow's Goldeneye	Garrot d'Islande	*Bucephala islandica*
Bufflehead	Petit Garrot	*Bucephala albeola*
Hooded Merganser	Harle couronné	*Lophodytes cucullatus*
Common Merganser	Grand Harle	*Mergus merganser*
Red-breasted Merganser	Harle huppé	*Mergus serrator*

Appendix 2. Standardized method of calculating indicated pairs (IP) from the Black Duck Joint Venture helicopter survey in Eastern Canada.

Sighting Combination[1]				Number of Indicated Pairs (IP)					
				Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
M	F	U	T	Dabbler (except Black Duck)	American Black Duck	Diver (except Ring-necked Duck)	Ring-necked Duck	Canada Goose	Common Loon
1	0	0	1	1	1	1	1	1	1
0	1	0	1	0	1	0	0	1	1
0	0	1	1	0	1	0	0	1	1
2	0	0	2	2	1,5	2	2	1	1
1	1	0	2	1	1,5	1	1	1	1
1	0	1	2	1	1,5	1	1	1	1
0	2	0	2	0	1,5	0	0	1	1
0	1	1	2	0	1,5	0	0	1	1
0	0	2	2	0	1,5	0	0	1	1
3	0	0	3	3	3	3	3	1	0
2	1	0	3	2	3	2	2	1	0
2	0	1	3	2	3	2	2	1	0
1	2	0	3	1	3	1	1	1	0
1	1	1	3	1	3	1	1	1	0
1	0	2	3	1	3	1	1	1	0
0	3	0	3	0	3	0	0	1	0
0	2	1	3	0	3	0	0	1	0
0	1	2	3	0	3	0	0	1	0
0	0	3	3	0	3	0	0	1	0
4	0	0	4	4	4	4	4	0	0
3	1	0	4	0	4	3	3	0	0
3	0	1	4	3	4	3	3	0	0
2	2	0	4	2	4	2	2	0	0
2	1	1	4	2	4	2	2	0	0
2	0	2	4	2	4	2	2	0	0
1	3	0	4	1	4	1	1	0	0
1	2	1	4	1	4	1	1	0	0
1	1	2	4	1	4	1	1	0	0
1	0	3	4	1	4	1	1	0	0
0	4	0	4	0	4	0	0	0	0
0	3	1	4	0	4	0	0	0	0
0	2	2	4	0	4	0	0	0	0
0	1	3	4	0	4	0	0	0	0
0	0	4	4	0	4	0	0	0	0
1	x	x	>4	0	0	0	1	0	0
2	x	x	>4	0	0	0	2	0	0
3	x	x	>4	0	0	0	3	0	0
4	x	x	>4	0	0	0	4	0	0
>4	x	x	>4	0	0	0	0	0	0

[1]M: male; F: female; U: unknown sex; T: total.